FIG. 1

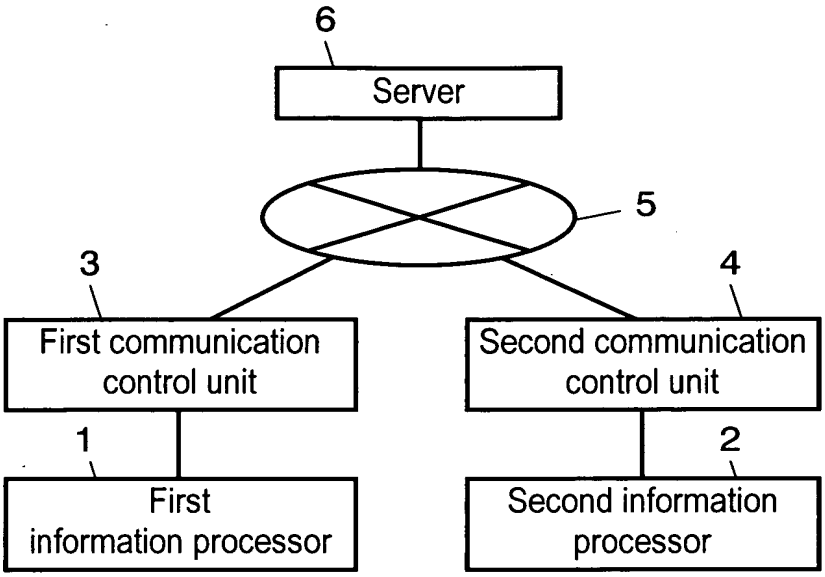
6
Server
5
3
4
First communication control unit
Second communication control unit
1
2
First information processor
Second information processor

FIG. 2

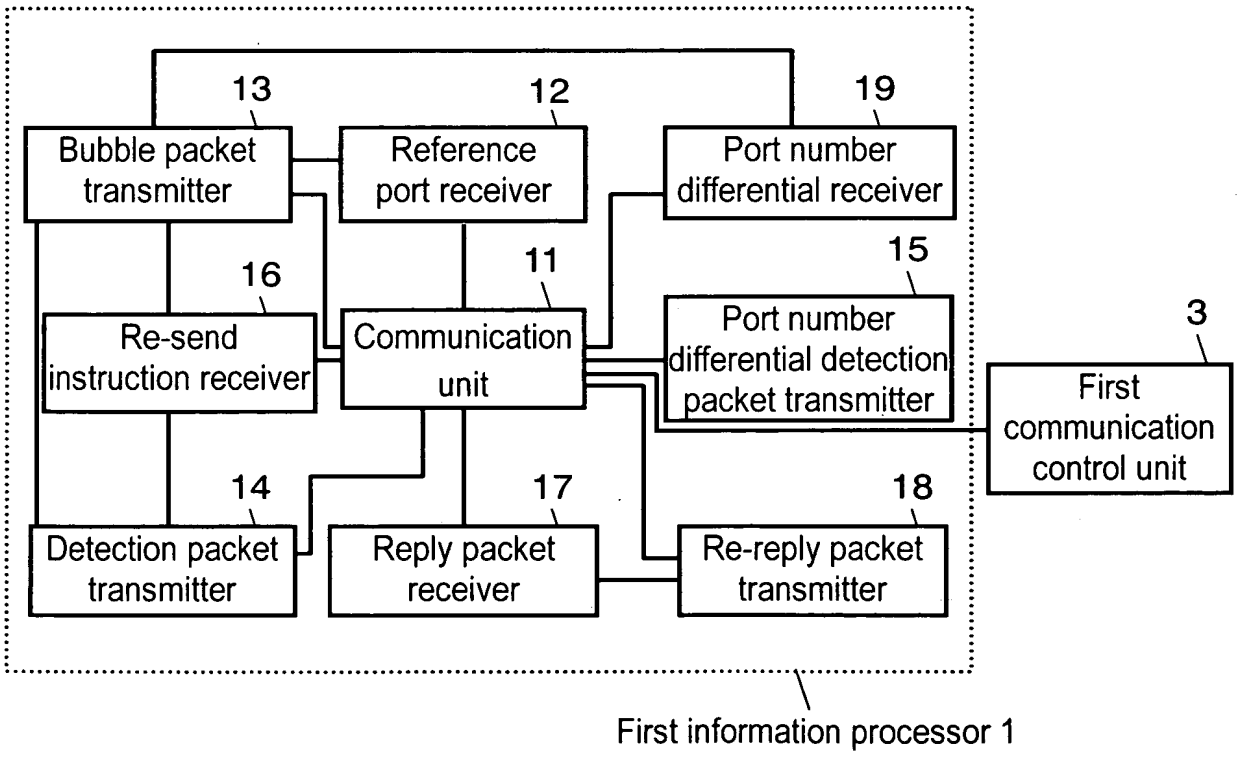
13
12
19
Bubble packet transmitter
Reference port receiver
Port number differential receiver
16
11
15
Re-send instruction receiver
Communication unit
Port number differential detection packet transmitter
3
First communication control unit
14
17
18
Detection packet transmitter
Reply packet receiver
Re-reply packet transmitter
First information processor 1

FIG. 3

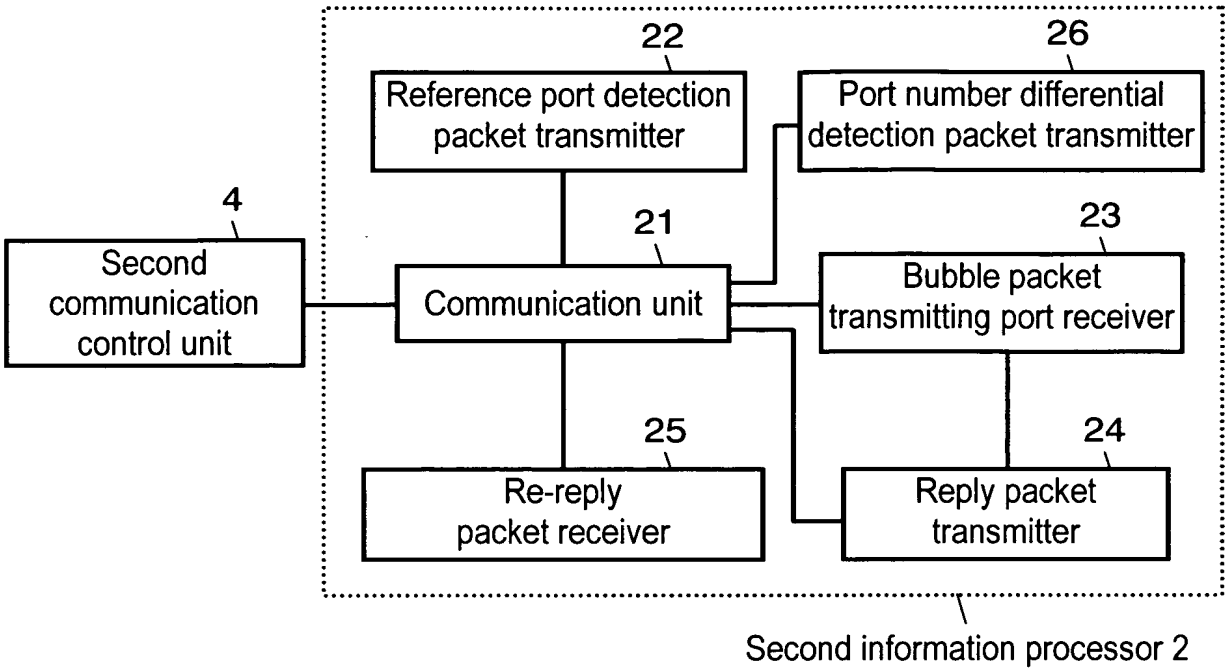
22
Reference port detection packet transmitter
26
Port number differential detection packet transmitter
4
Second communication control unit
21
Communication unit
23
Bubble packet transmitting port receiver
25
Re-reply packet receiver
24
Reply packet transmitter
Second information processor 2

FIG. 4

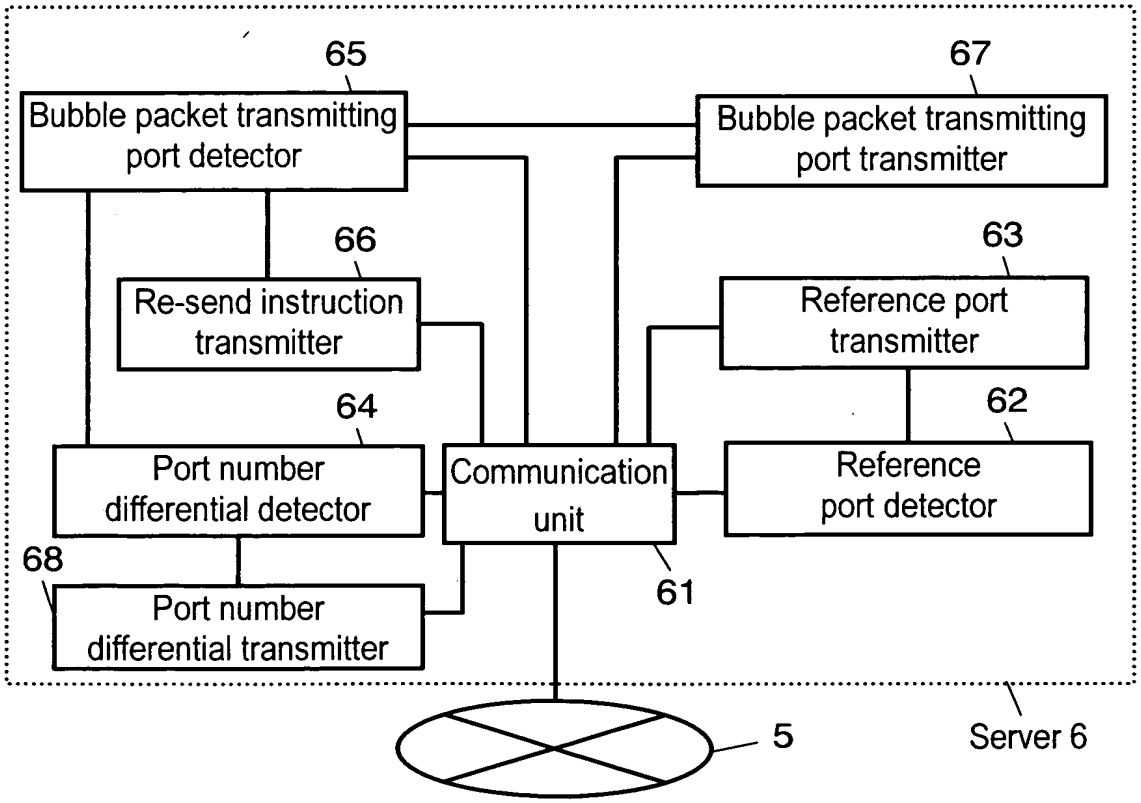
65
Bubble packet transmitting port detector
67
Bubble packet transmitting port transmitter
66
Re-send instruction transmitter
63
Reference port transmitter
64
Port number differential detector
Communication unit
62
Reference port detector
68
Port number differential transmitter
61
5
Server 6

FIG. 5

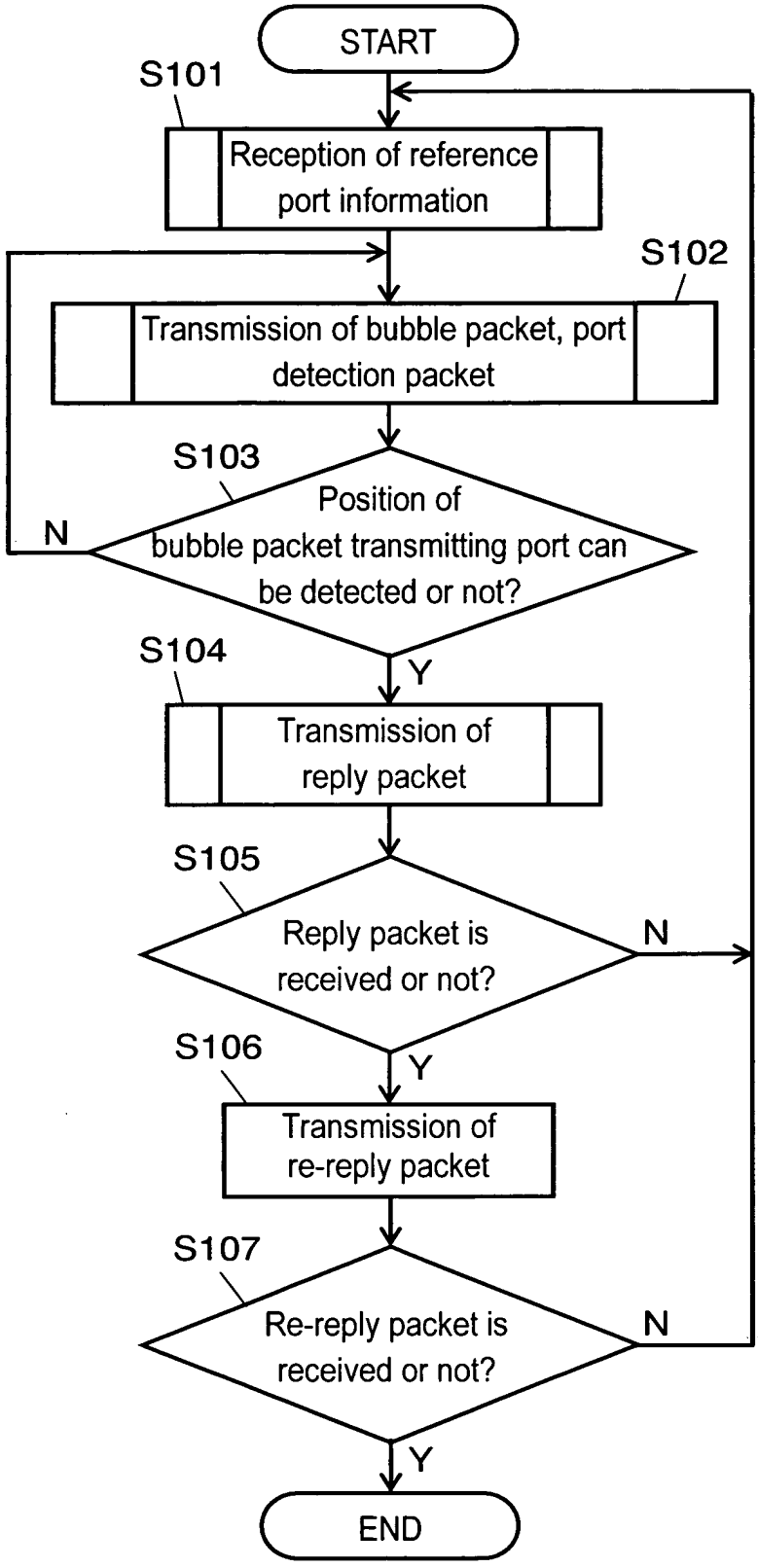
START
S101
Reception of reference port information
S102
Transmission of bubble packet, port detection packet
S103
Position of bubble packet transmitting port can be detected or not?
N
Y
S104
Transmission of reply packet
S105
Reply packet is received or not?
N
Y
S106
Transmission of re-reply packet
S107
Re-reply packet is received or not?
N
Y
END

FIG. 6

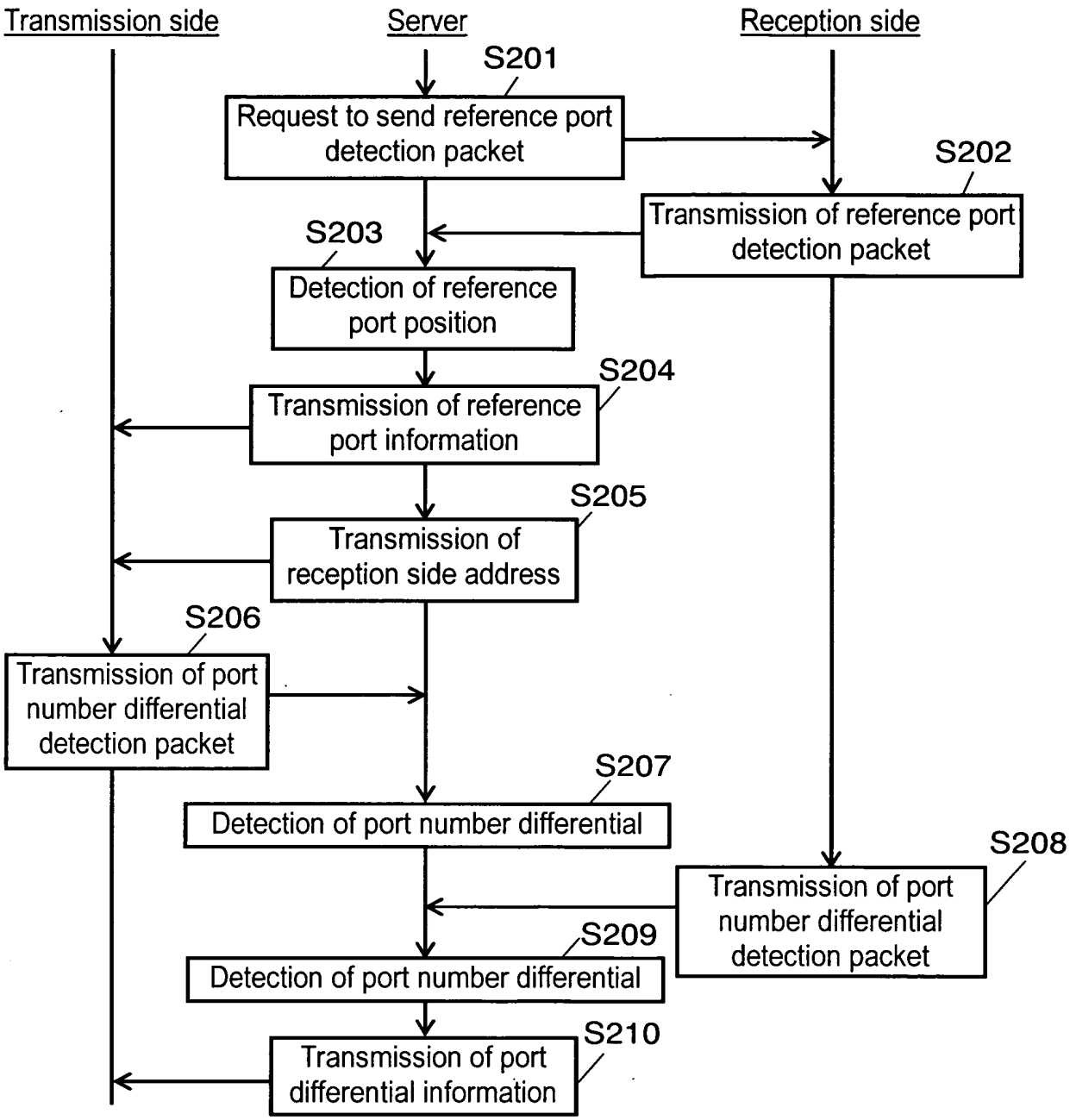
Transmission side
Server
Reception side
S201
Request to send reference port detection packet
S202
Transmission of reference port detection packet
S203
Detection of reference port position
S204
Transmission of reference port information
S205
Transmission of reception side address
S206
Transmission of port number differential detection packet
S207
Detection of port number differential
S208
Transmission of port number differential detection packet
S209
Detection of port number differential
S210
Transmission of port differential information

FIG. 7

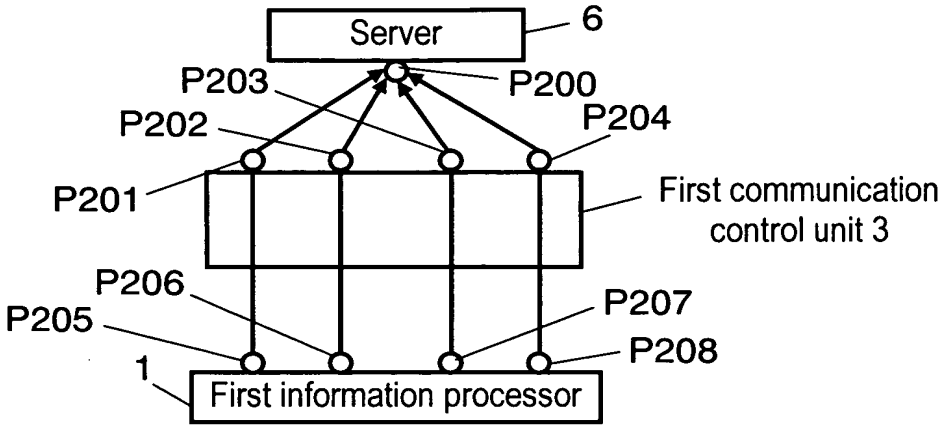
Server
6
P203
P200
P202
P204
P201
First communication control unit 3
P206
P205
P207
P208
1
First information processor

FIG. 8

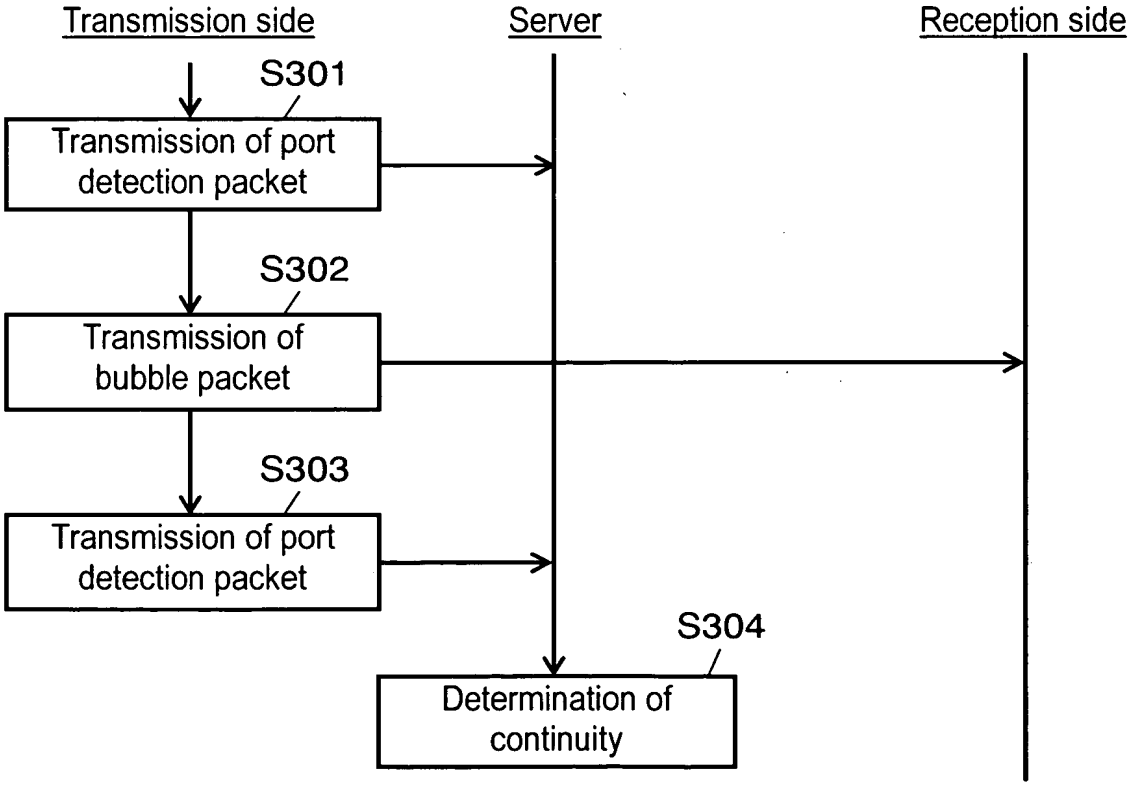
Transmission side
Server
Reception side
S301
Transmission of port detection packet
S302
Transmission of bubble packet
S303
Transmission of port detection packet
S304
Determination of continuity

FIG. 9

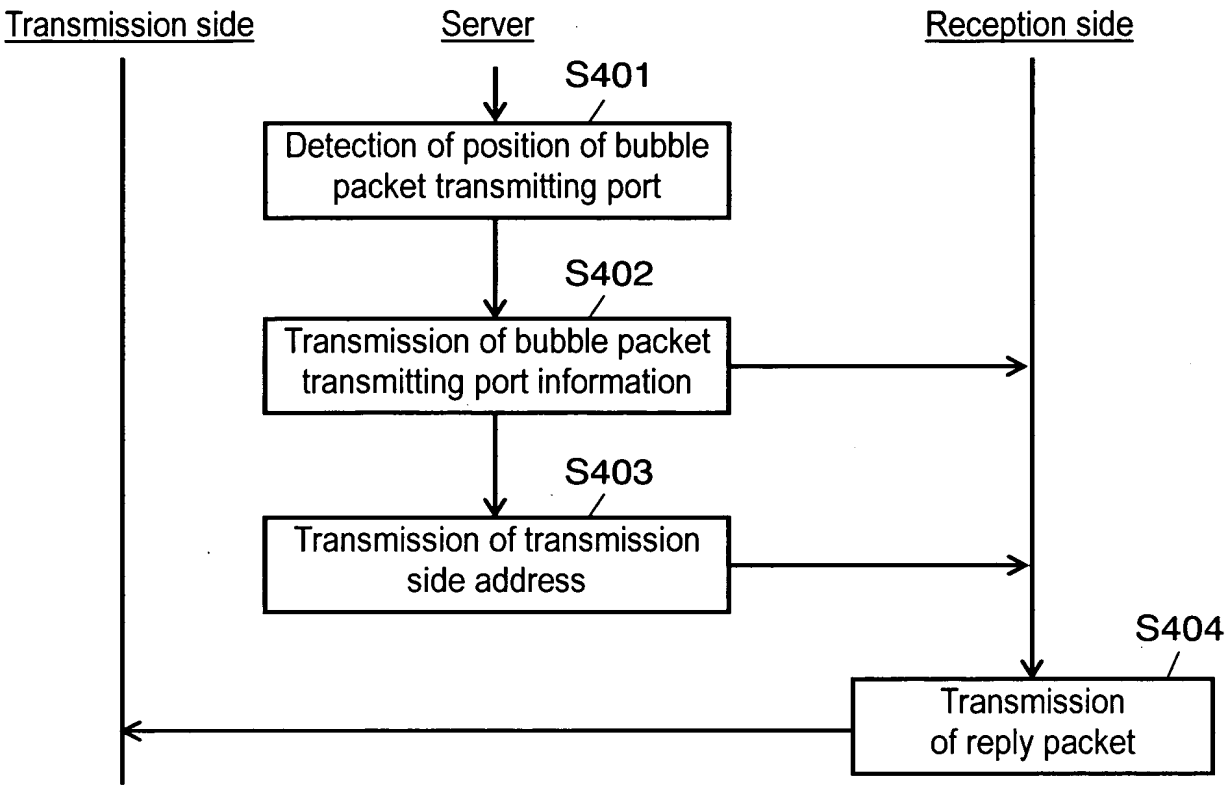
Transmission side
Server
Reception side
S401
Detection of position of bubble packet transmitting port
S402
Transmission of bubble packet transmitting port information
S403
Transmission of transmission side address
S404
Transmission of reply packet

FIG. 10

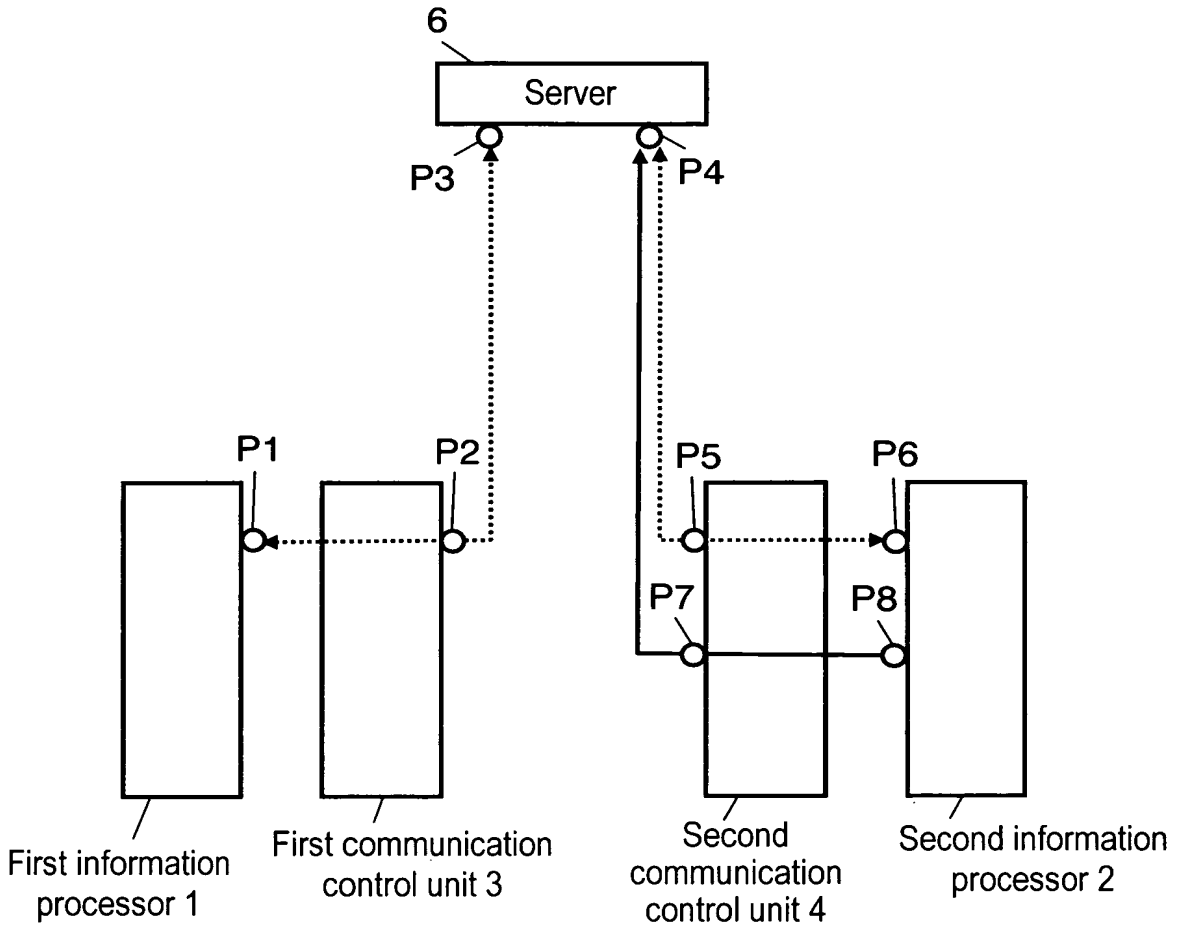
6
Server
P3
P4
P1
P2
P5
P6
P7
P8
First information processor 1
First communication control unit 3
Second communication control unit 4
Second information processor 2

FIG. 11

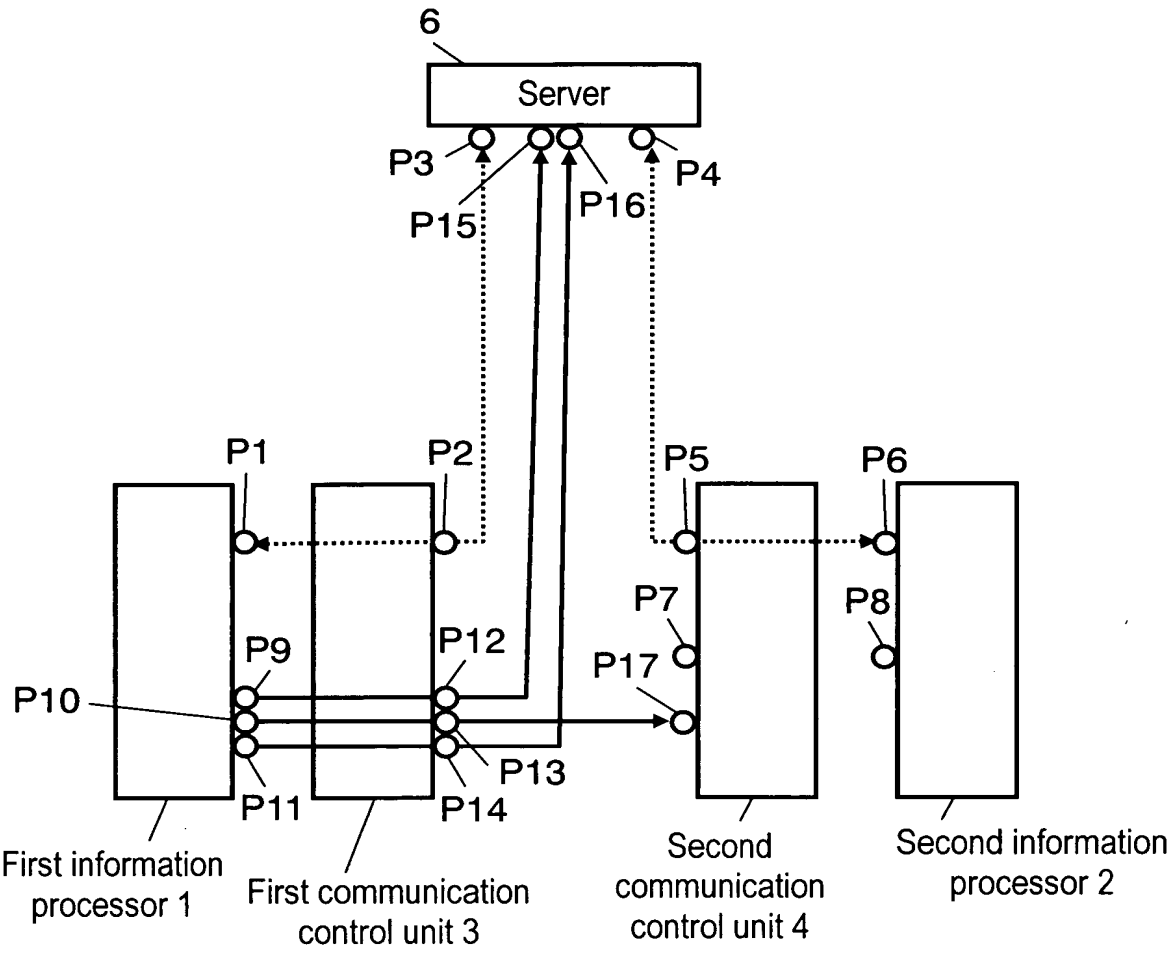
6
Server
P3
P4
P15
P16
P1
P2
P5
P6
P7
P8
P9
P12
P17
P10
P13
P11
P14
First information processor 1
First communication control unit 3
Second communication control unit 4
Second information processor 2

FIG. 12

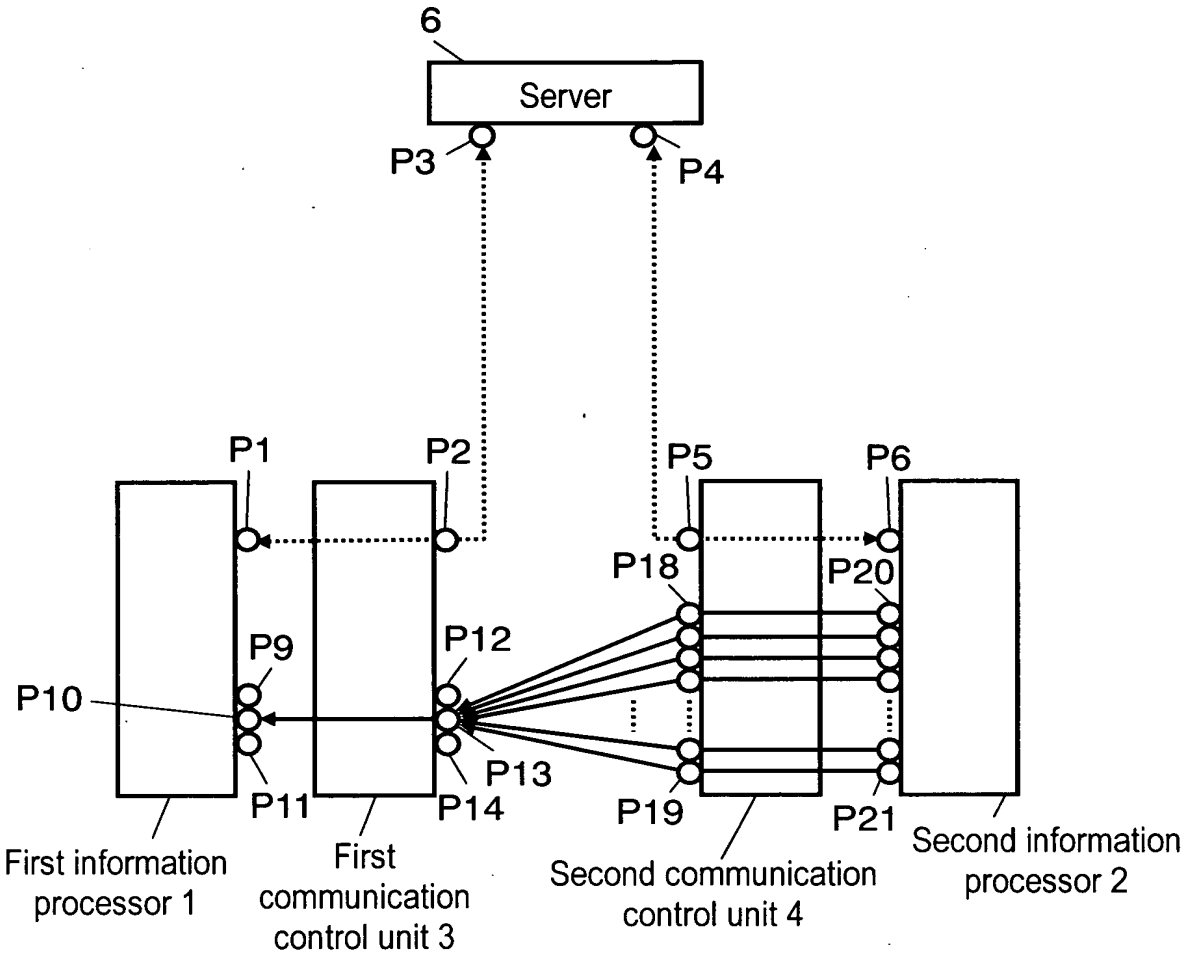
6
Server
P3
P4
P1
P2
P5
P6
P18
P20
P9
P12
P10
P13
P11
P14
P19
P21
First information processor 1
First communication control unit 3
Second communication control unit 4
Second information processor 2

FIG. 13

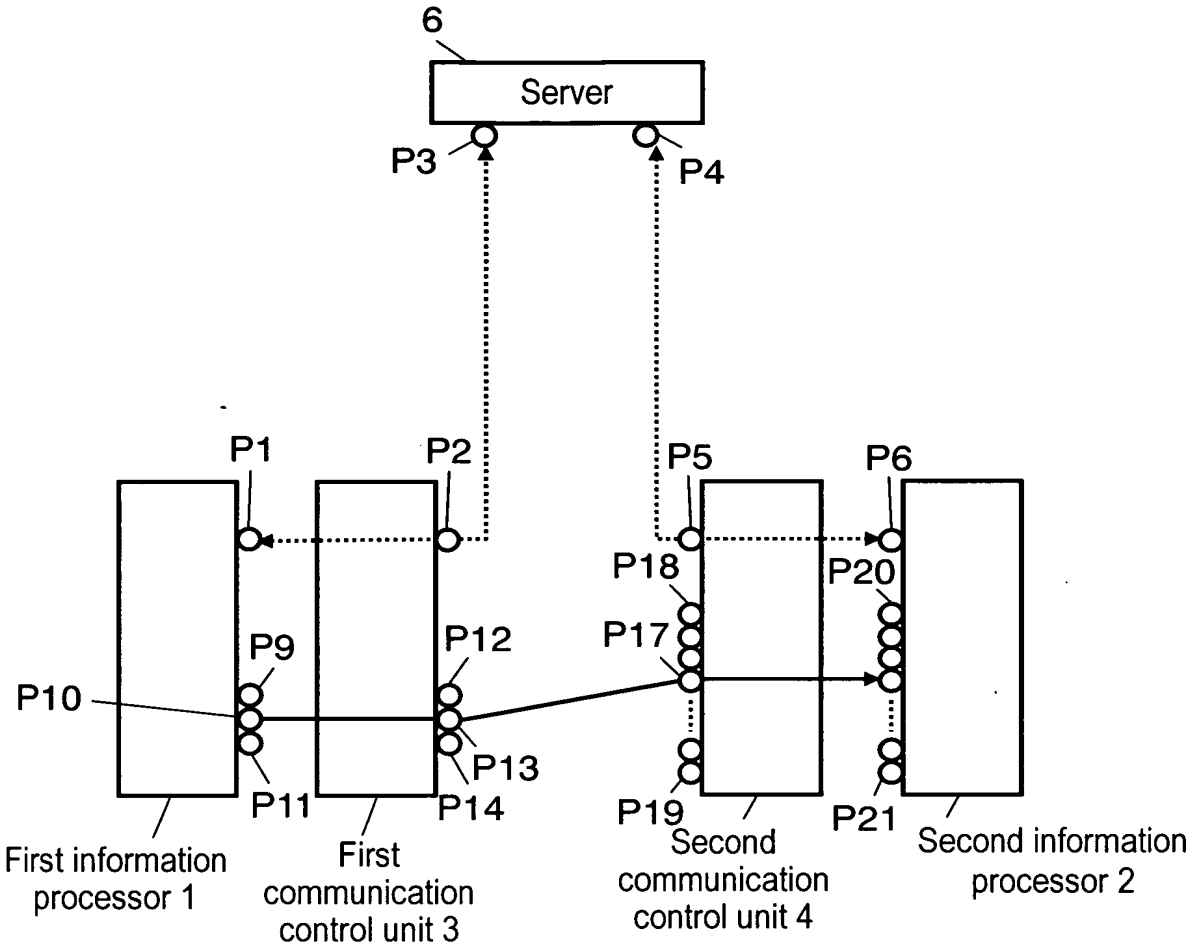
6
Server
P3
P4
P1
P2
P5
P6
P18
P20
P17
P9
P12
P10
P13
P11
P14
P19
P21
First information processor 1
First communication control unit 3
Second communication control unit 4
Second information processor 2

FIG. 14

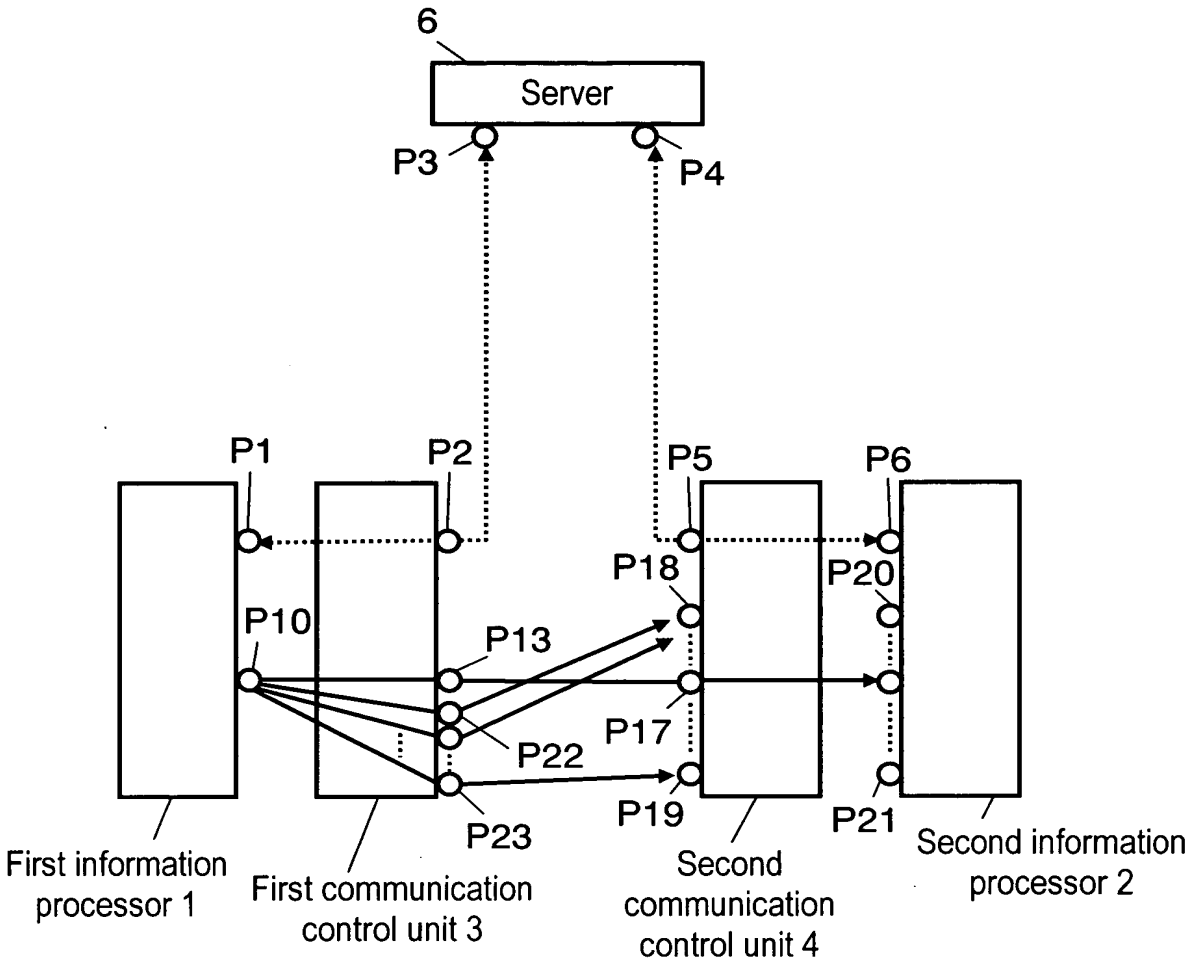
6
Server
P3
P4
P1
P2
P5
P6
P18
P20
P10
P13
P17
P22
P19
P21
P23
First information processor 1
First communication control unit 3
Second communication control unit 4
Second information processor 2

FIG. 15

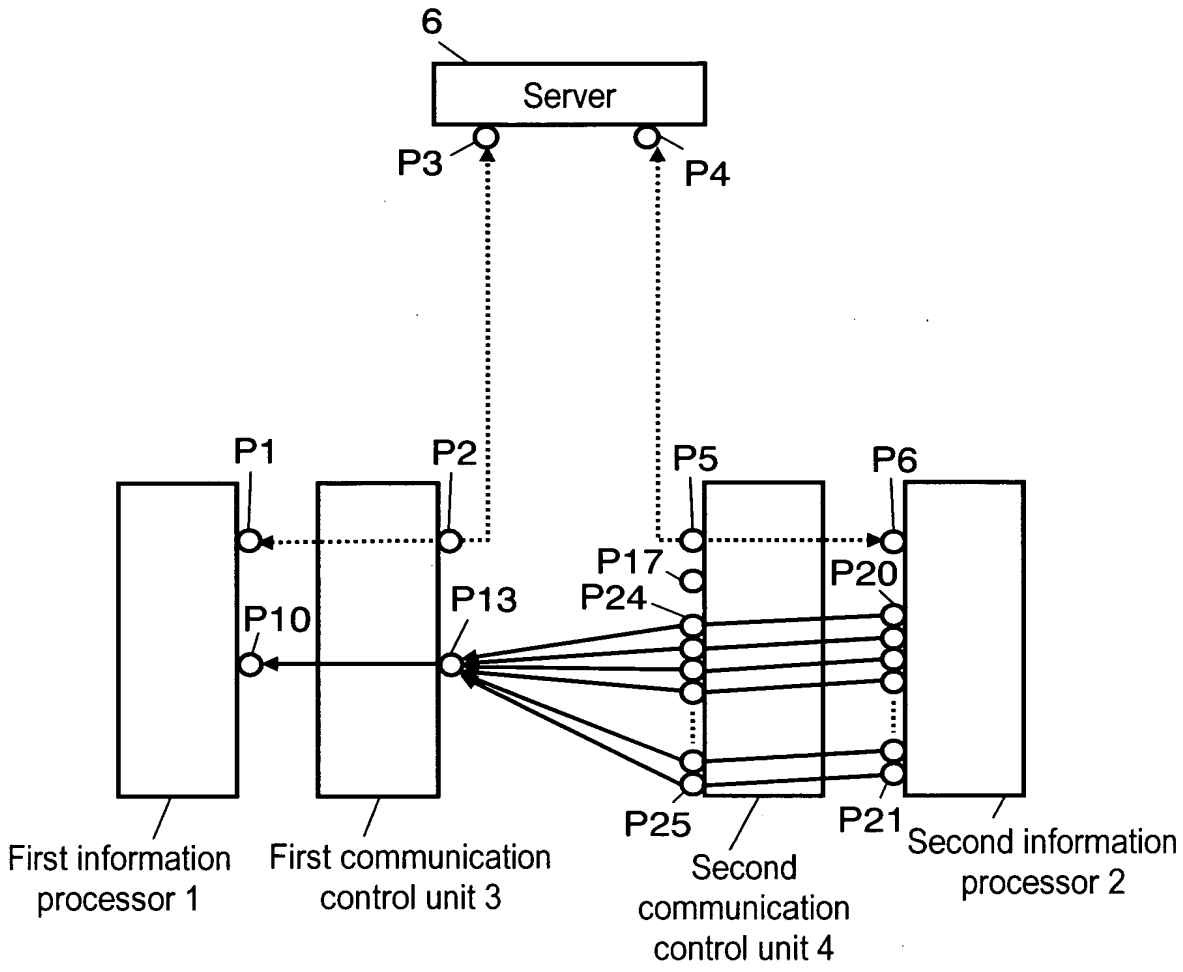
6
Server
P3
P4
P1
P2
P5
P6
P17
P24
P20
P10
P13
P25
P21
First information processor 1
First communication control unit 3
Second communication control unit 4
Second information processor 2

FIG. 16

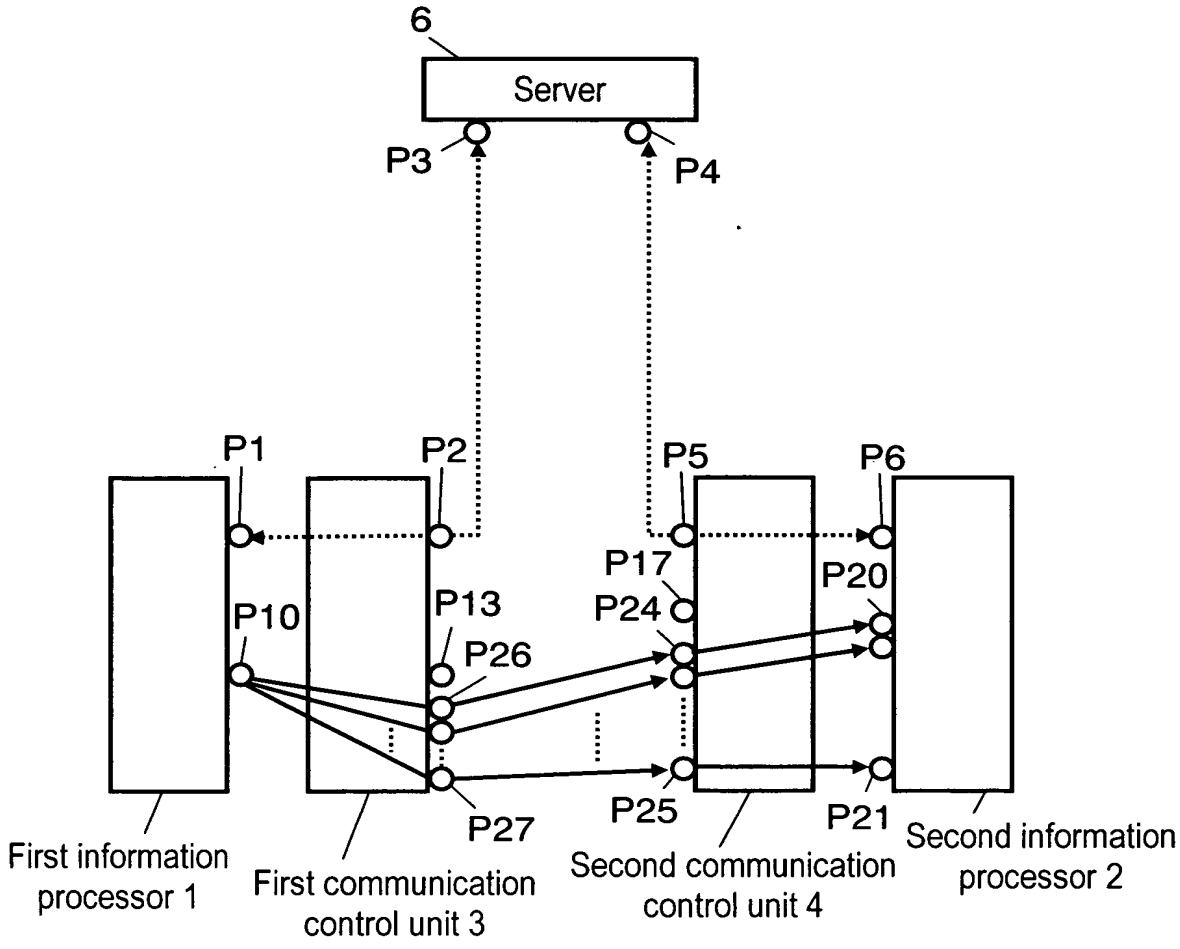
6
Server
P3
P4
P1
P2
P5
P6
P17
P20
P10
P13
P24
P26
P27
P25
P21
First information processor 1
First communication control unit 3
Second communication control unit 4
Second information processor 2

FIG. 17

Transmission side \ Reception side	O	F	R	PR	Sa	AS	Sc	Sd	Se	PS
O	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
F	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
R	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
PR	O	O	O	O	O	O	O	O	O	O
Sa	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
AS	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
Sc	O	O	O	O	O	O	O	O	O	O
Sd	◎	◎	◎	O	◎	◎	O	◎	◎	O
Se	◎	◎	◎	O	◎	◎	O	◎	◎	O
PS	O	O	O	O	O	O	O	O	O	O

O : Connection enabled if position of bubble packet transmitting port can be detected and reply packet is sent by using target port for transmitting bubble packet

◎ : Connection enabled if position of bubble packet transmitting port can be detected

O : Open NAT
F : Full Cone NAT
R : Restricted NAT
PR : Port Restricted NAT
Sa : Symmetric NAT A
AS(Sb) : Address Sensitive Symmetric NAT
Sc : Symmetric NAT C
Sd : Symmetric NAT D
Se : Symmetric NAT E
PS(Sf) : Port Sensitive Symmetric NAT

FIG. 18

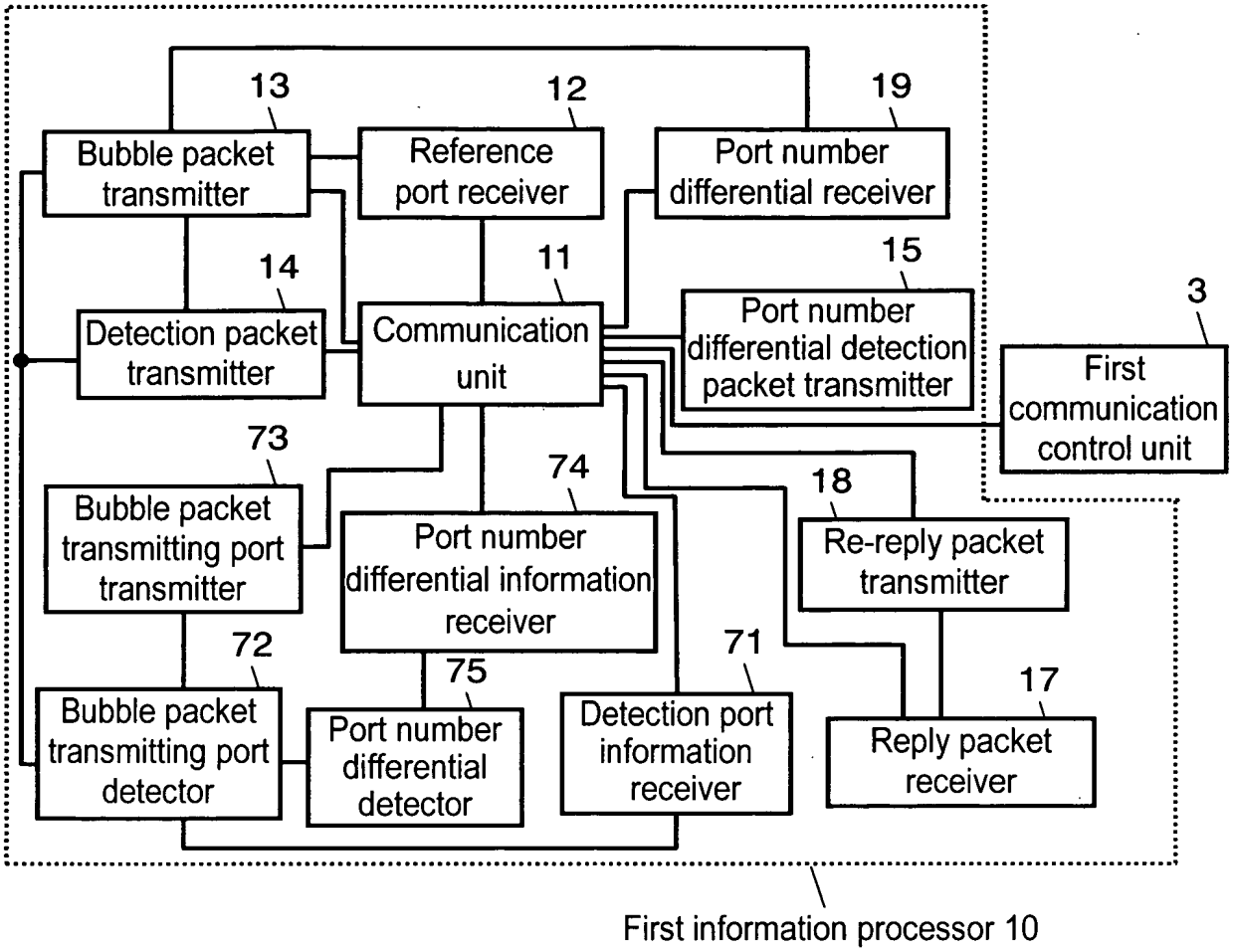
13
12
19
Bubble packet transmitter
Reference port receiver
Port number differential receiver
14
11
15
3
Detection packet transmitter
Communication unit
Port number differential detection packet transmitter
First communication control unit
73
74
18
Bubble packet transmitting port transmitter
Port number differential information receiver
Re-reply packet transmitter
72
75
71
17
Bubble packet transmitting port detector
Port number differential detector
Detection port information receiver
Reply packet receiver
First information processor 10

FIG. 19

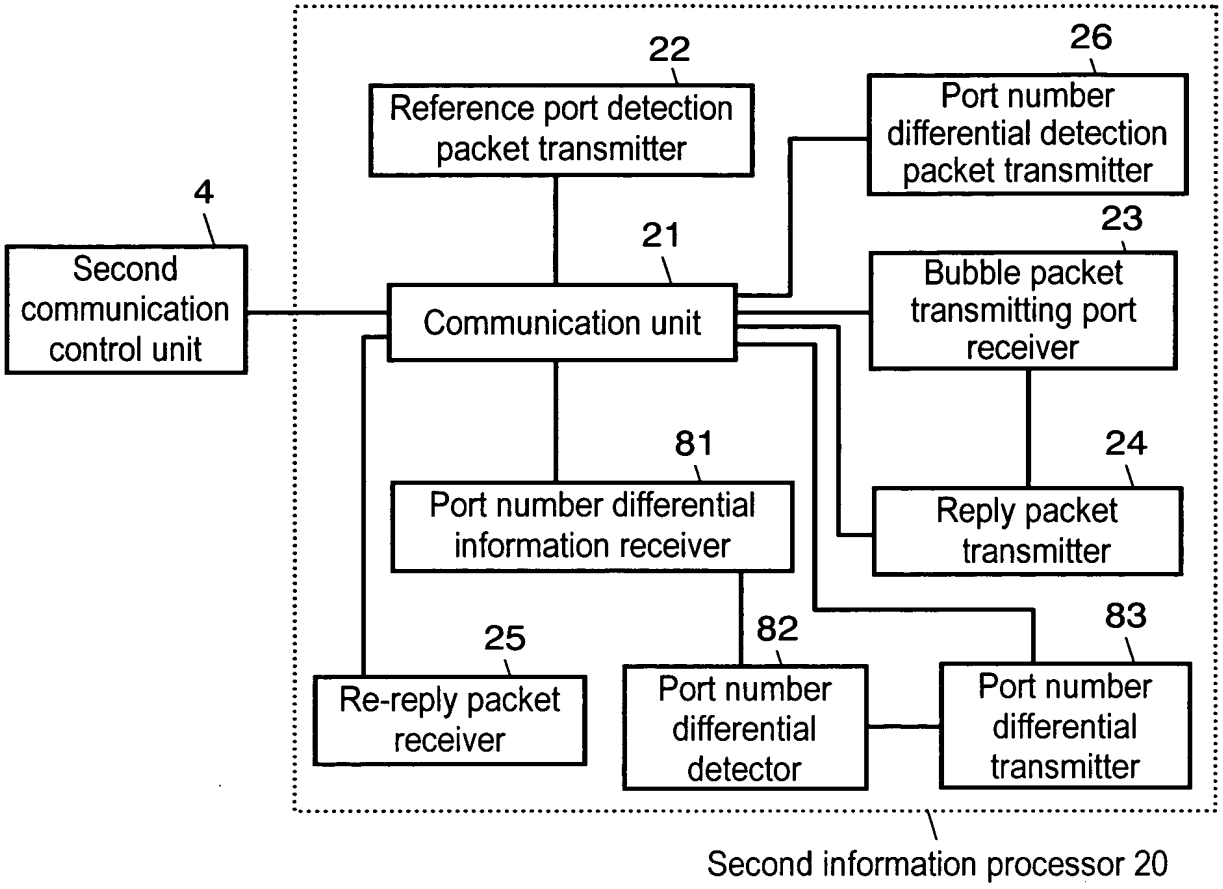
22
Reference port detection packet transmitter
26
Port number differential detection packet transmitter
4
Second communication control unit
21
Communication unit
23
Bubble packet transmitting port receiver
81
Port number differential information receiver
24
Reply packet transmitter
25
Re-reply packet receiver
82
Port number differential detector
83
Port number differential transmitter
Second information processor 20

FIG. 20

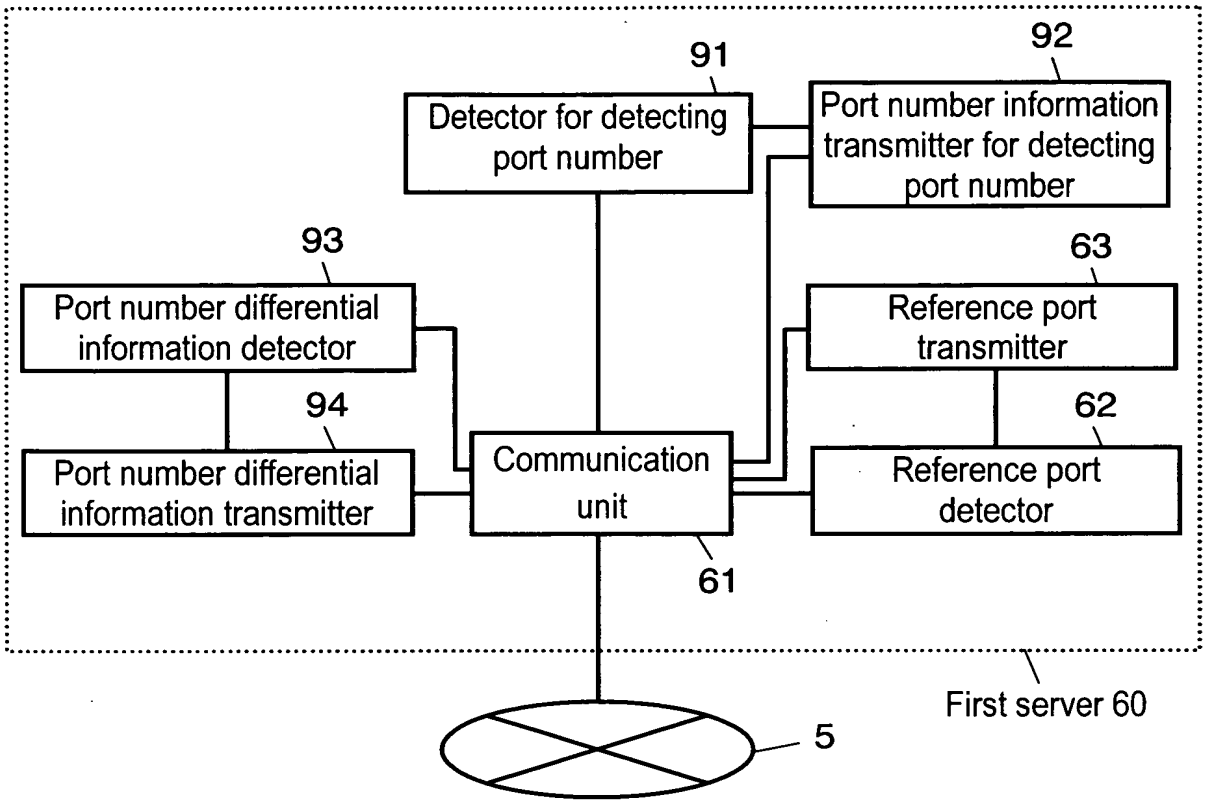
91
92
Detector for detecting port number
Port number information transmitter for detecting port number
93
63
Port number differential information detector
Reference port transmitter
94
62
Port number differential information transmitter
Communication unit
Reference port detector
61
First server 60
5

FIG. 21

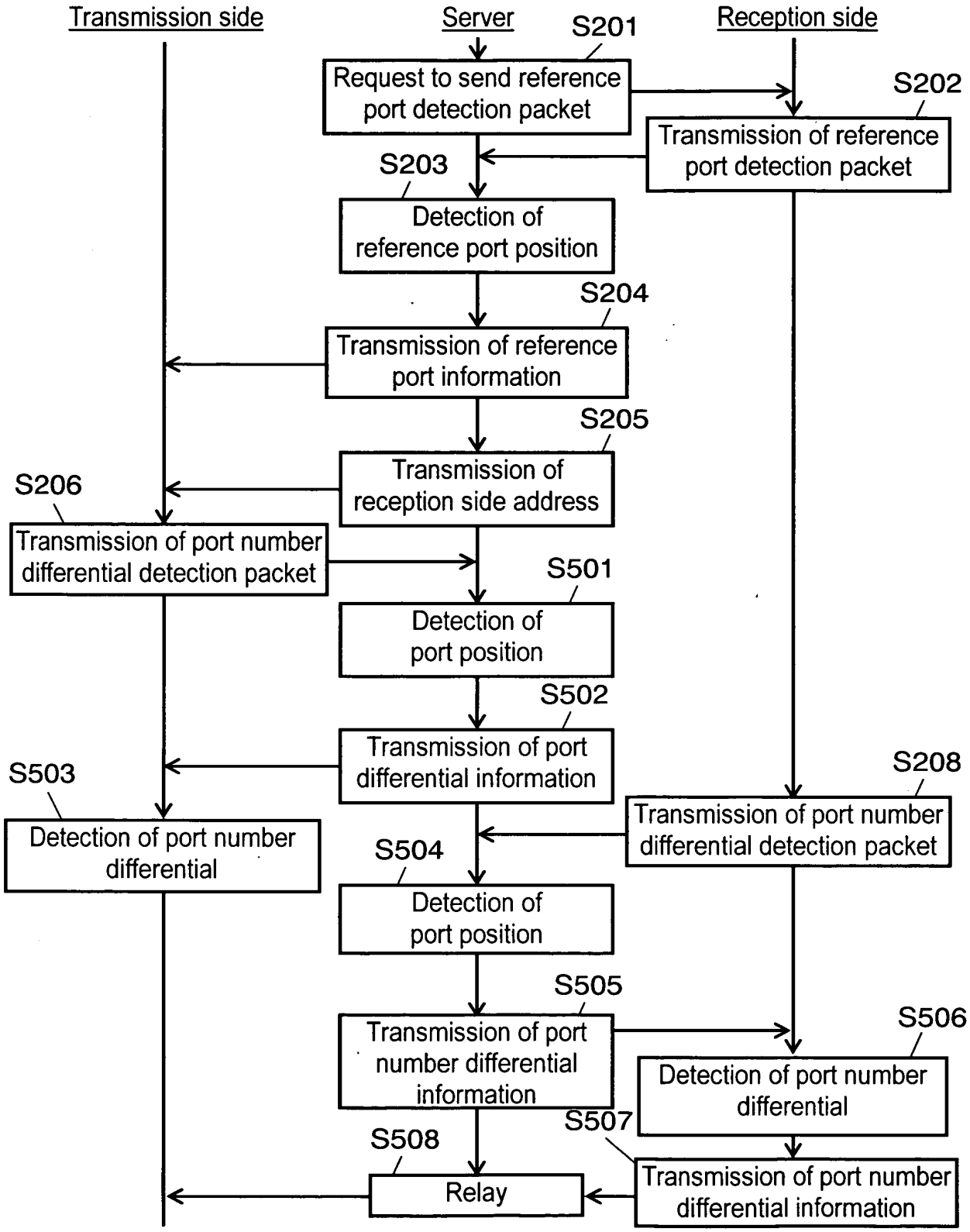
Transmission side
Server
Reception side
S201
Request to send reference port detection packet
S202
Transmission of reference port detection packet
S203
Detection of reference port position
S204
Transmission of reference port information
S205
Transmission of reception side address
S206
Transmission of port number differential detection packet
S501
Detection of port position
S502
Transmission of port differential information
S503
Detection of port number differential
S208
Transmission of port number differential detection packet
S504
Detection of port position
S505
Transmission of port number differential information
S506
Detection of port number differential
S507
Transmission of port number differential information
S508
Relay

FIG. 22

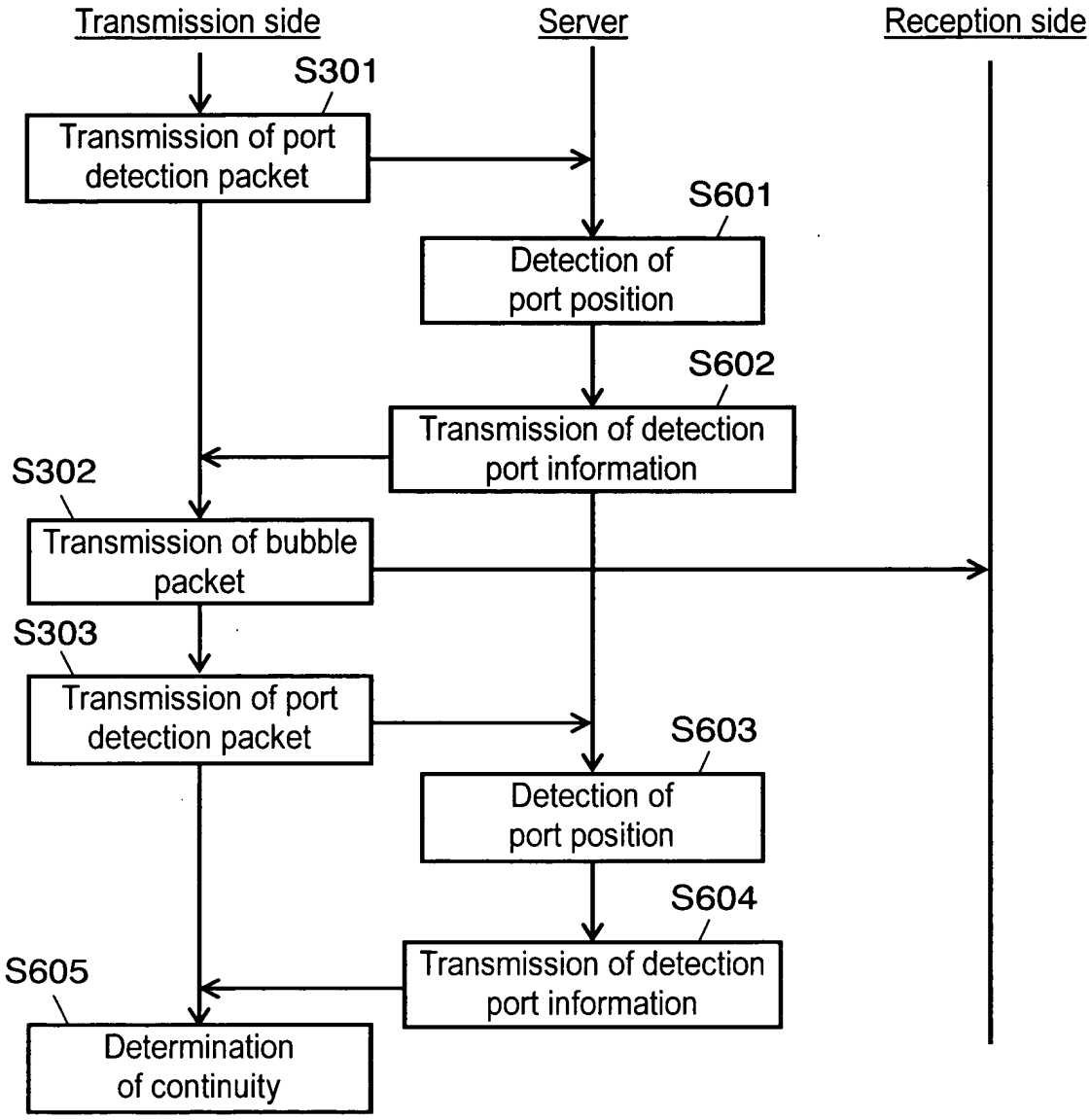
Transmission side
Server
Reception side
S301
Transmission of port detection packet
S601
Detection of port position
S602
Transmission of detection port information
S302
Transmission of bubble packet
S303
Transmission of port detection packet
S603
Detection of port position
S604
Transmission of detection port information
S605
Determination of continuity

FIG. 23

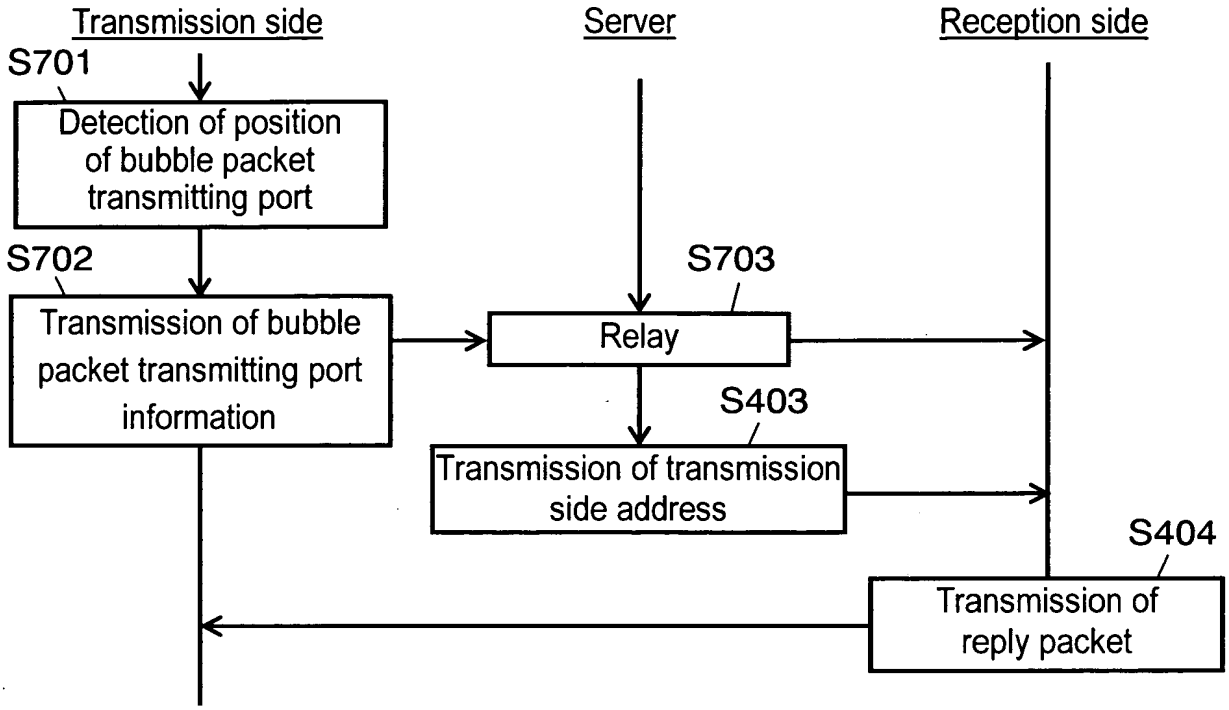
Transmission side
Server
Reception side
S701
Detection of position of bubble packet transmitting port
S702
Transmission of bubble packet transmitting port information
S703
Relay
S403
Transmission of transmission side address
S404
Transmission of reply packet

FIG. 24

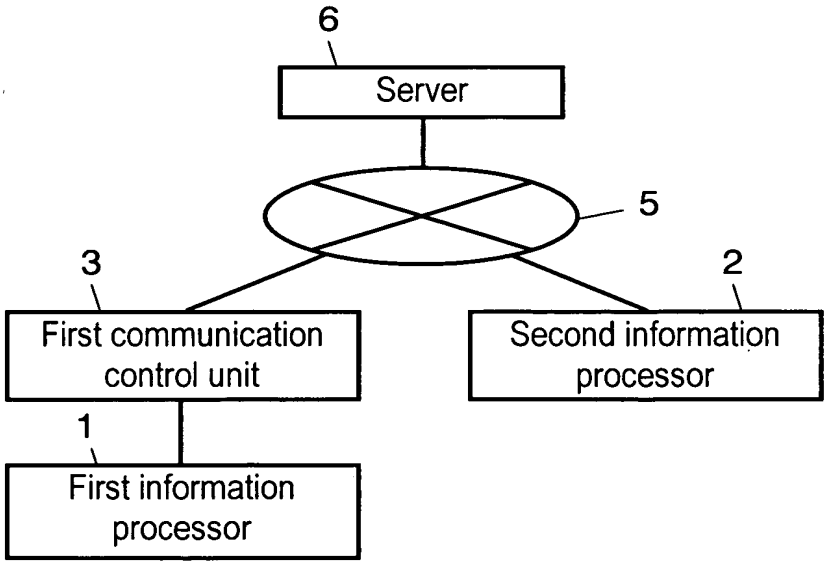
6
Server
5
3
2
First communication control unit
Second information processor
1
First information processor

FIG. 25

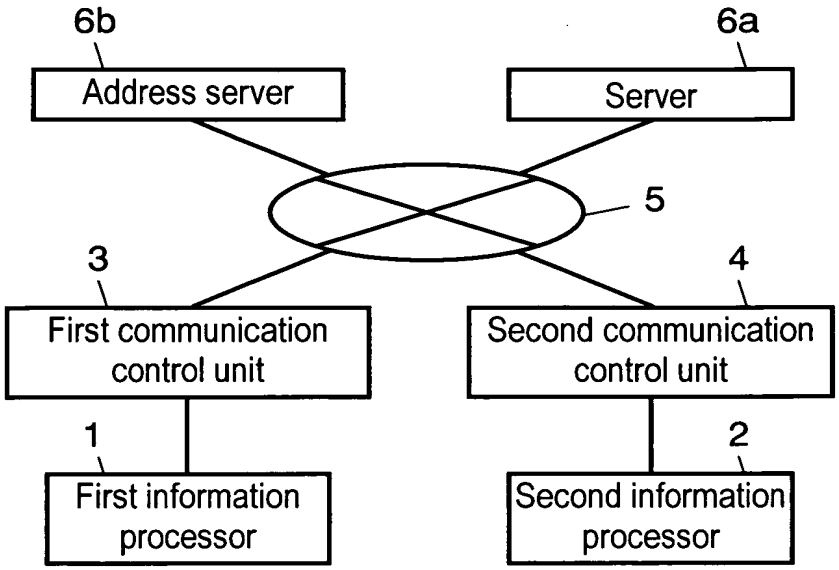
6b
Address server
6a
Server
5
3
First communication control unit
4
Second communication control unit
1
First information processor
2
Second information processor

FIG. 26

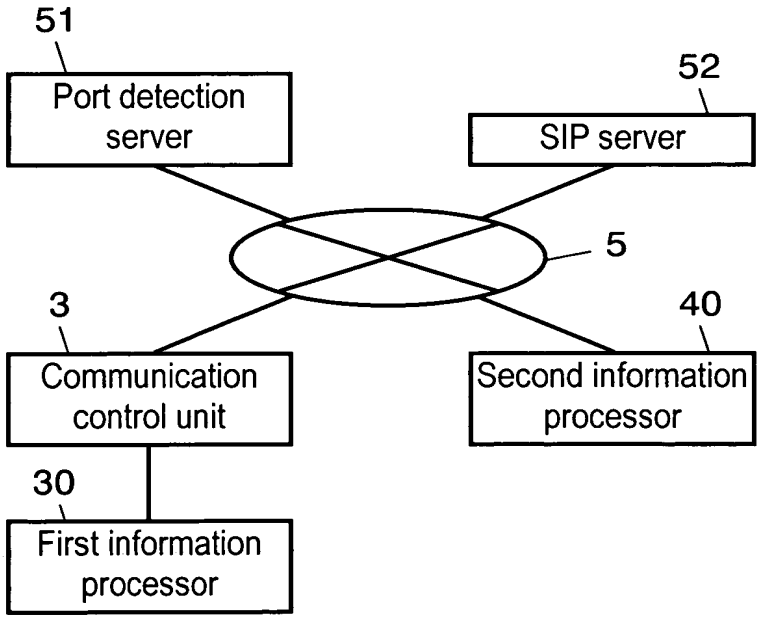
51
Port detection server
52
SIP server
5
3
Communication control unit
40
Second information processor
30
First information processor

FIG. 27

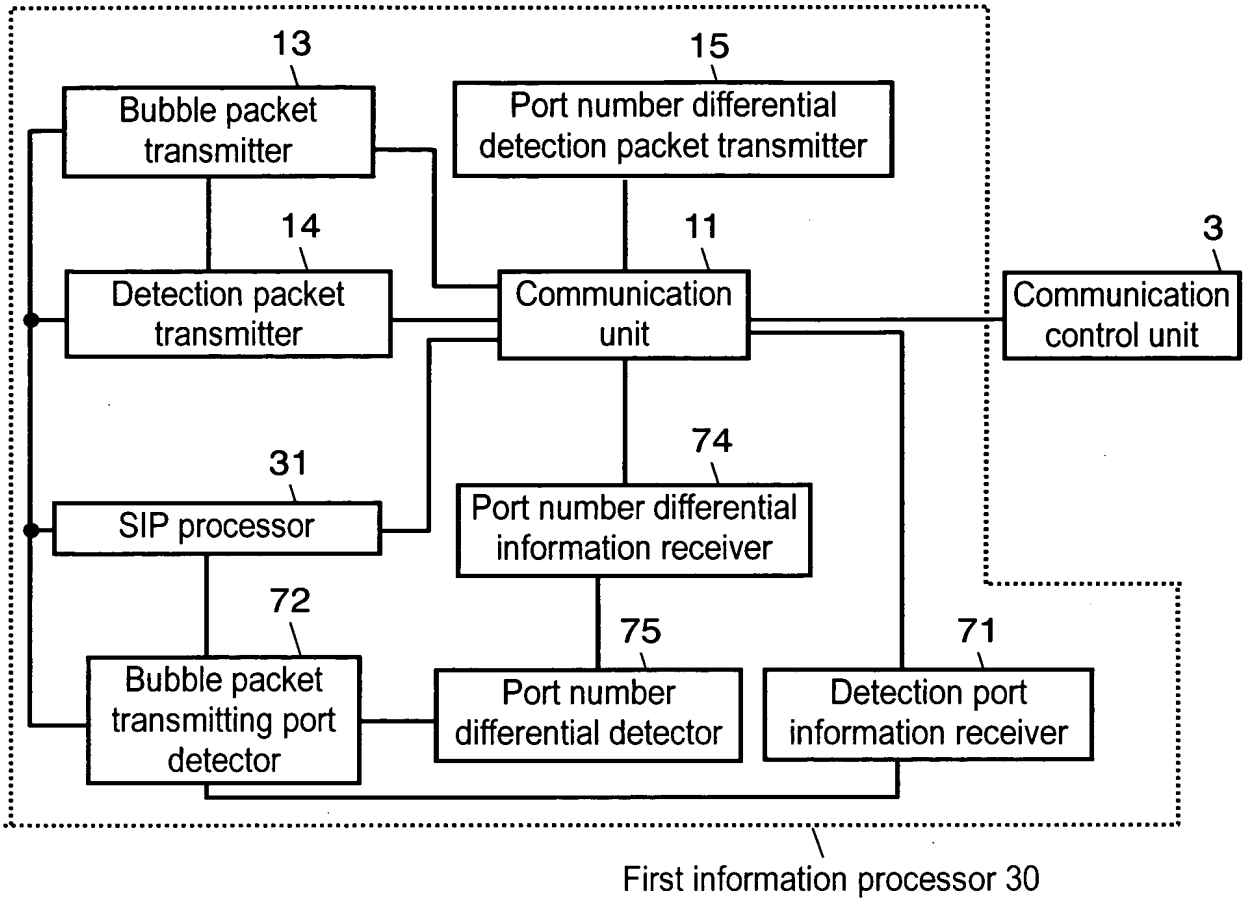
13
Bubble packet transmitter
15
Port number differential detection packet transmitter
14
Detection packet transmitter
11
Communication unit
3
Communication control unit
31
SIP processor
74
Port number differential information receiver
72
Bubble packet transmitting port detector
75
Port number differential detector
71
Detection port information receiver
First information processor 30

FIG. 28

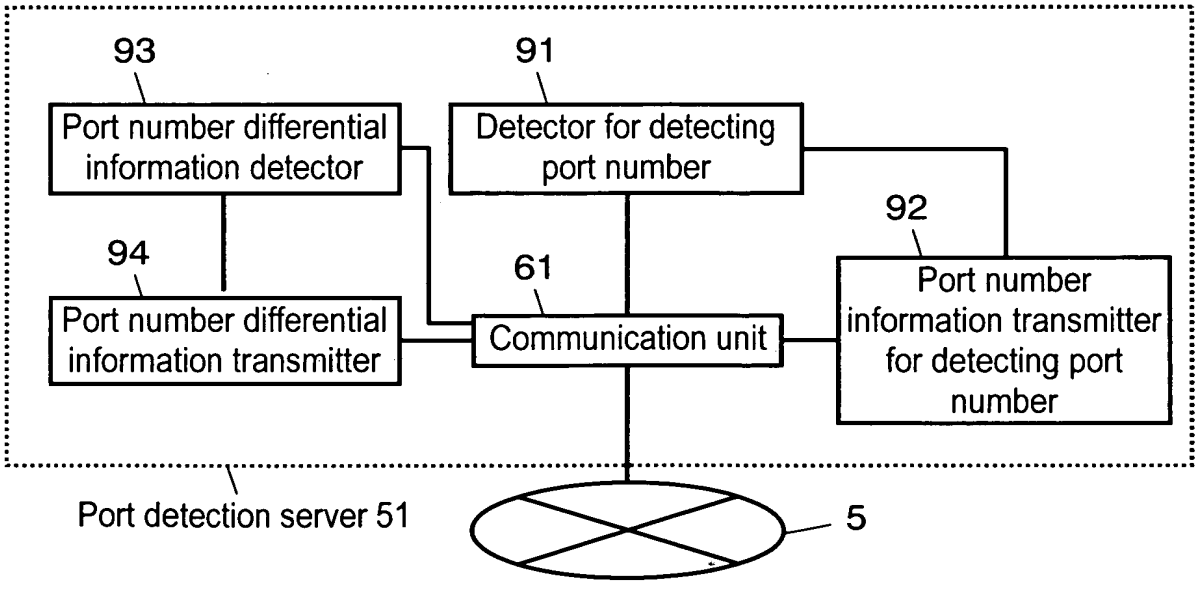
93
Port number differential information detector
91
Detector for detecting port number
92
94
Port number differential information transmitter
61
Communication unit
Port number information transmitter for detecting port number
Port detection server 51
5

FIG. 29

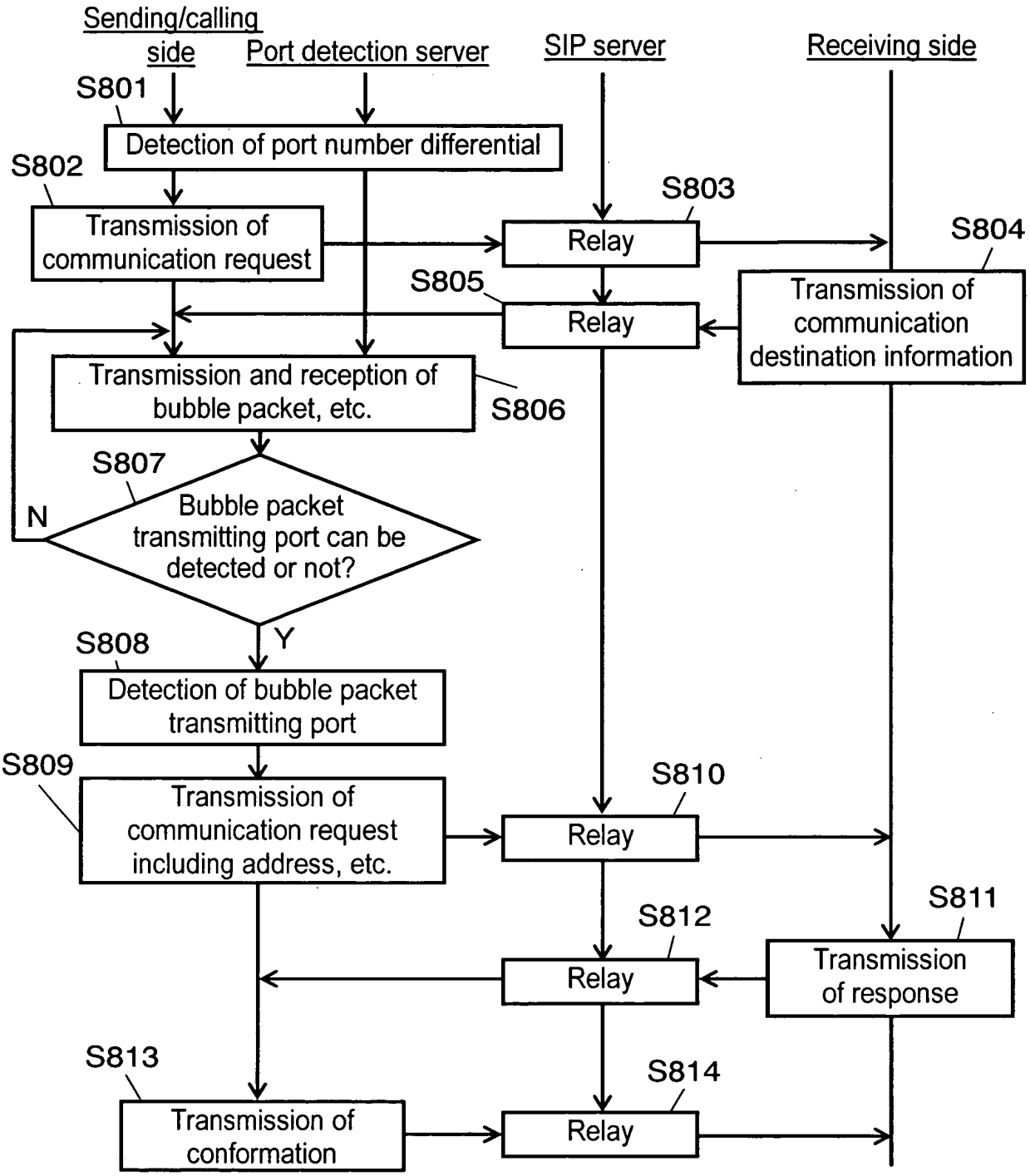
Sending/calling side
Port detection server
SIP server
Receiving side
S801
Detection of port number differential
S802
Transmission of communication request
S803
Relay
S804
Transmission of communication destination information
S805
Relay
Transmission and reception of bubble packet, etc.
S806
S807
Bubble packet transmitting port can be detected or not?
N
Y
S808
Detection of bubble packet transmitting port
S809
Transmission of communication request including address, etc.
S810
Relay
S811
Transmission of response
S812
Relay
S813
Transmission of conformation
S814
Relay

FIG. 30

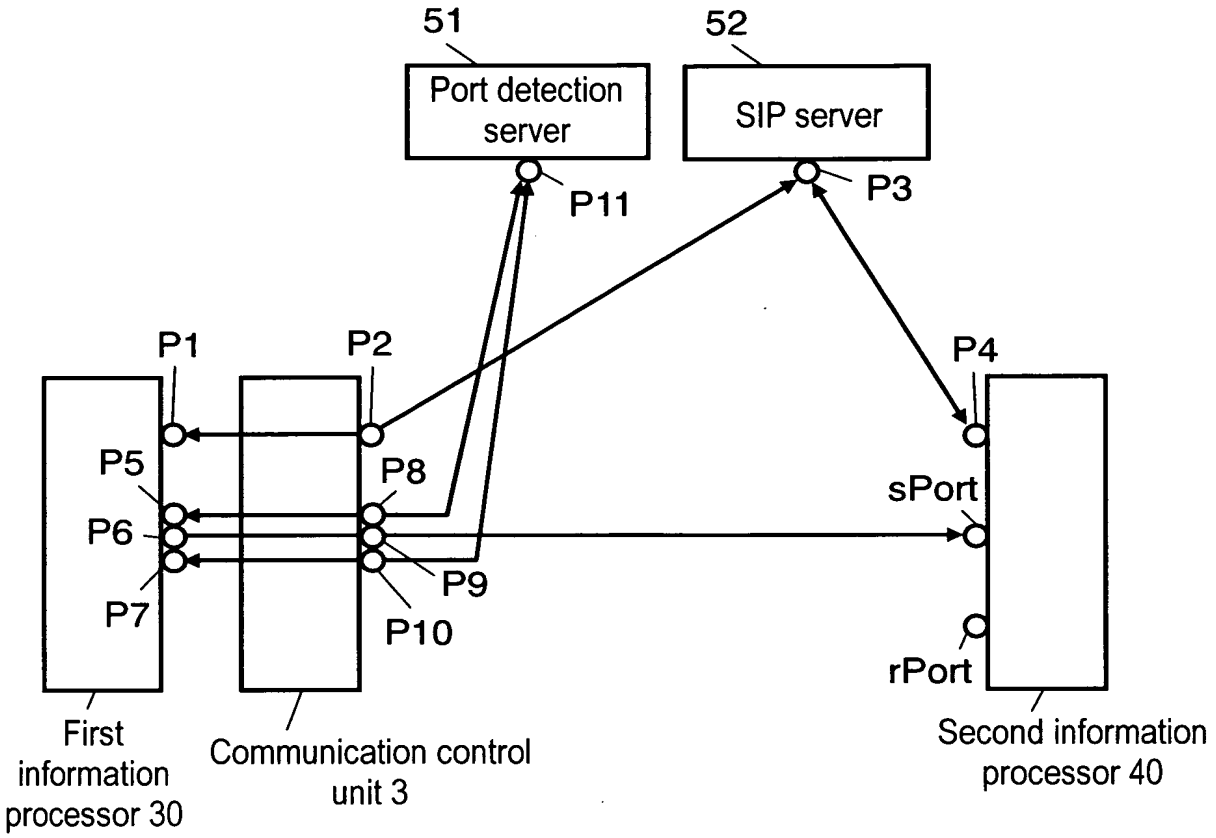
51
52
Port detection server
SIP server
P11
P3
P1
P2
P4
P5
P8
sPort
P6
P9
P7
P10
rPort
First information processor 30
Communication control unit 3
Second information processor 40

FIG. 31

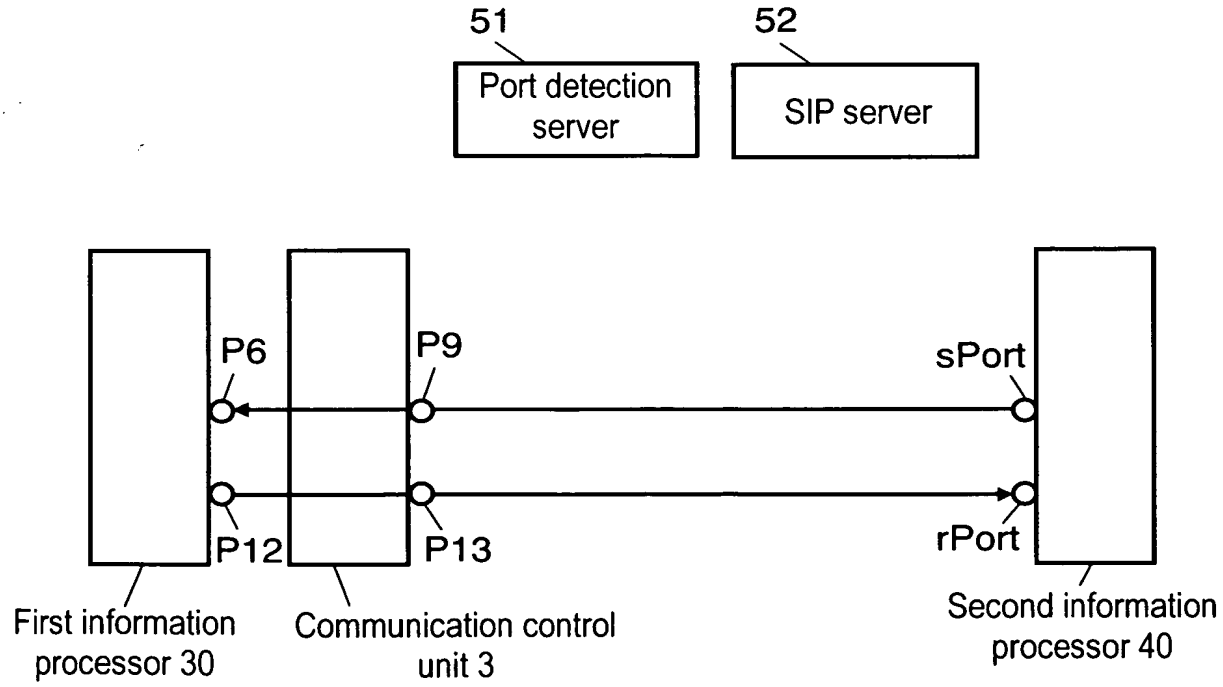
51
52
Port detection server
SIP server
P6
P9
sPort
P12
P13
rPort
First information processor 30
Communication control unit 3
Second information processor 40

FIG. 32

Filter rule / Port assigning rule	No Filter	AS Filter	PS Filter
Cone	Full Cone	Restricted Cone	Port Restricted Cone
AS	Symmetric(a)	AS NAT Symmetric(b)	Symmetric(c)
PS	Symmetric(d)	Symmetric(e)	PS NAT Symmetric(f)

FIG. 33

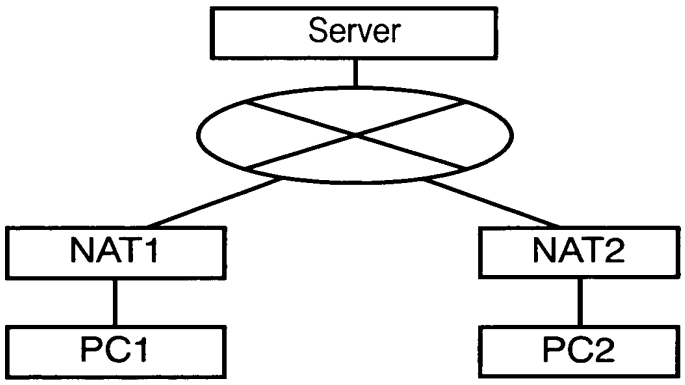

FIG. 34

Transmission side \ Reception side	F NAT	R NAT	PR NAT	AS NAT	PS NAT
F NAT	O * 1	O * 1	O * 1	O * 2	O * 2
R NAT	O * 1	O * 1	O * 1	O * 2	O * 2
PR NAT	O * 1	O * 1	O * 1	O * 3	O * 3
AS NAT	O * 1	O * 1	O * 3	O * 3	O * 3

O : Connection enabled
× : Connection disabled